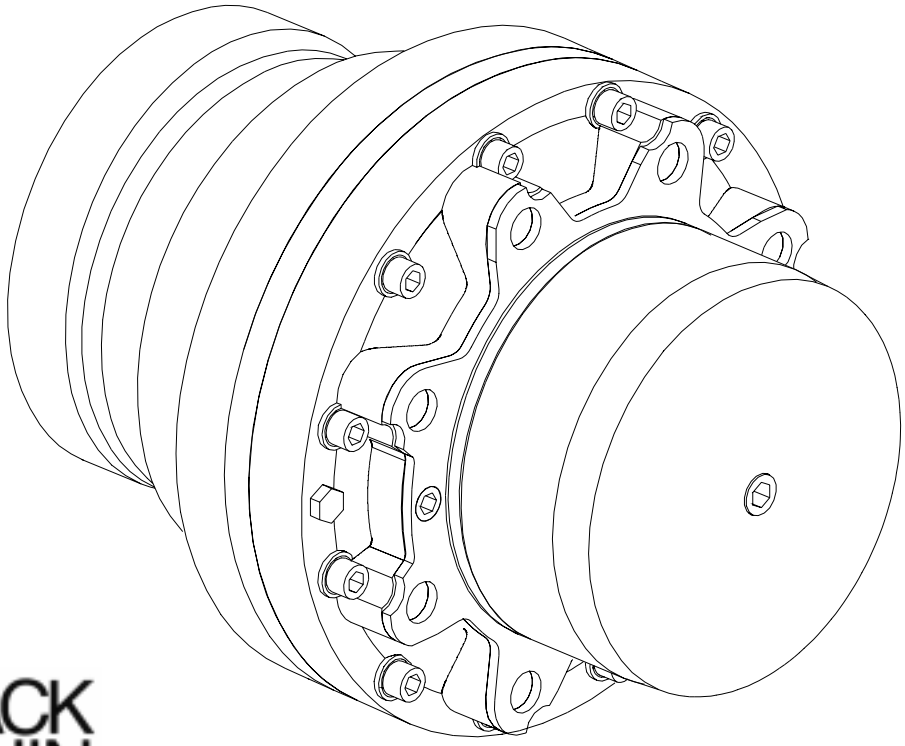

BLACK BRUIN
HYDRAULIC MOTORS

BBC-serie

Service and maintenance manual

Motor with brake

Santasalo Hydraulics Oy
PO Box 633, 40101 Jyväskylä, Finland
Tel. +358 2048 4130, fax. +358 2048 4131
e-mail: info.hydraulics@santasalo.com
http://www.santasalohydraulics.com

santasalo
A member of Metso Corporation

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MOTOR DISMANTLING

1. Before dismantling

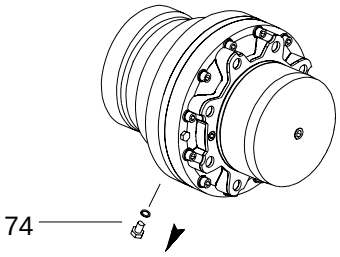
- Remove the motor from the system and plug the oil connections.

- Clean the motor externally.

- Where possible, test run the motor on the test bench in order to determine any hydraulic system related faults.

NOTE! When testing motors with multi-disc brakes, make sure that the wheel attachment bolts are properly tightened, the two brake cover fixing screws will not withstand the braking torque during testing.

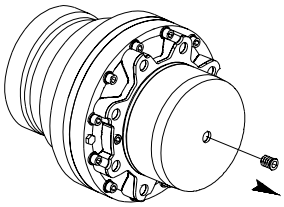
- Empty any oil from the motor housing by unscrewing the bleed screws (part 74).



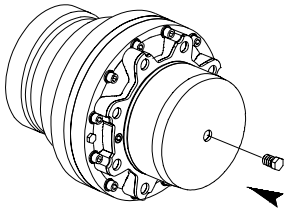
2. Dismantling the brake

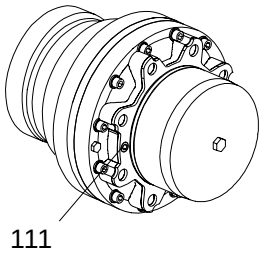
Place the motor on the work bench with the brake cover pointing upwards.

1. Loosen the tapered plug in the centre of the brake cover using an allen wrench.

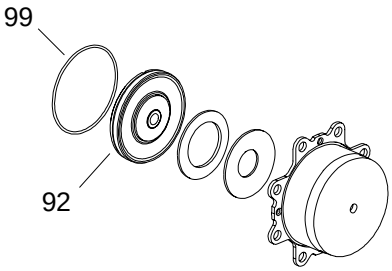


2. Insert the brake release bolt with nut into the hole in the center of the brake housing. Screw the bolt with nut into the bottom of tapped hole located on the brake piston. Tighten the release **nut** one full turn in order to release the brake.





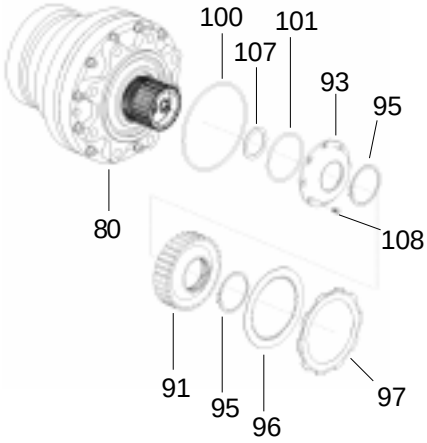
3. Remove the brake cover lock screws (part 111) using allen key. Carefully lift the brake cover straight upwards.



4. If the brake piston o-ring (part 99) is leaking, loosen the brake release bolt from the brake cover and release the brake piston (part 92) from the brake cover using a drift and a hammer. Replace the brake piston o-ring (part 99).

5. Remove brake discs (parts 96 and 97).

6. Remove the retainer ring (part 95) from its groove and take out the splined hub (part 91).



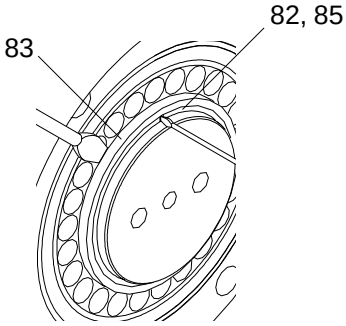
7. Remove the inner retainer ring (part 95) from its groove [not in all models].

8. Loosen the spacer plate (part 93) lock screws (part 108) from the hub cover (part 80). Remove the spacer plate and its o-ring (part 101).

(Table 1) Spacer plate allen key sizes [mm]:

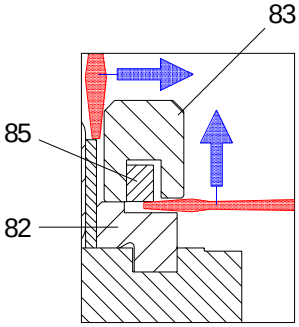
BBC01	BBC02	BBC03	BBC04	BBC05
5	6	6	5	6

9. Remove the sealing ring (part 107) from the shaft groove.



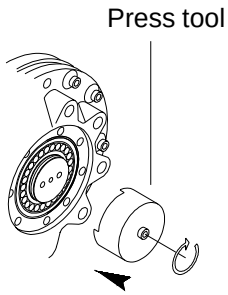
10. Remove the brake cover o-ring (part 100) from the hub cover.

3. Hub cover and bearing detachment



1. Place a small screwdriver between the retainer rings (part 82) and turn the clamp ring with the screwdriver (part 85) as far as possible. Pry the retainer ring (part 83) out using a large screwdriver.

Dismantling without hydraulic compression:

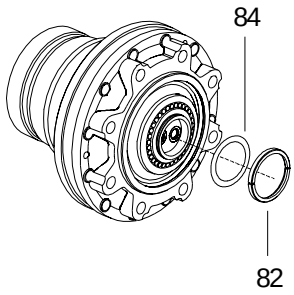


3. Place the press tool against the hub bearing. Screw M10 12,9 bolt through press tools hole. Pre-tighten the bearing but avoid overtightening. Max tightening torque is 77 Nm.

(Table 2) Press tool numbers:

BBC01	BBC02	BBC03	BBC04	BBC05
CN8704	CN8726	CN8692	CN8919	CN8718

Remove the retainer ring halves (part 82) through the press tool holes. Remove the press tool and detach the shims (part 84) [not in all models].



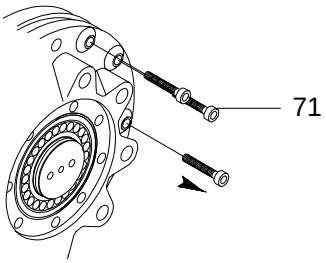
Dismantling with hydraulic compression:

2. Place the press tool against the hub bearing

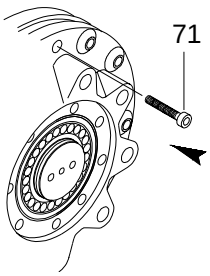
(Table 3) Press tool numbers:

BBC01	BBC02	BBC03	BBC04	BBC05
CN8704	CN8726	CN8692	CN8919	CN8718

Apply force to the bearing at 3...4 tons [6600...8800 lbs]. Remove the retainer ring halves (part 82) through the tool holes. Remove the press tool and detach the shims (part 84) [not in all models].



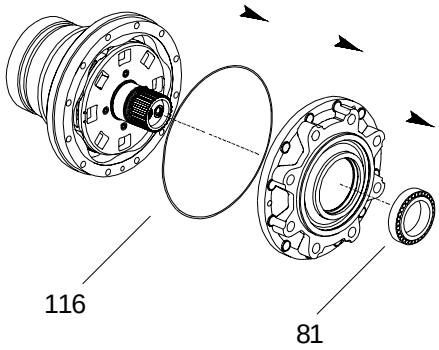
3. Unscrew and remove bolts (part 71) from the motor cover.



4. Screw 3 housing bolts (part 71) into the threaded extraction holes in the hub cover. Detach the hub cover with inner race of the bearing by evenly tightening the bolts.

5. You should not remove the outer bearing race from the hub cover unless the bearing is being replaced.

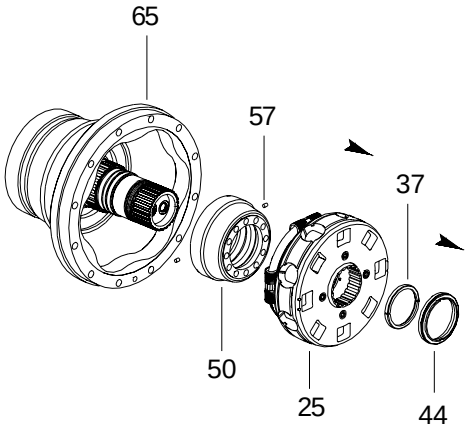
6. Remove the o-ring (part 116) from its groove.



4. Dismantling the cylinder block

1. Pry out the retainer ring (part 44) using a screwdriver. Detach the retainer ring halves (part 37) which are holding the cylinder block (part 25).

2. Carefully lift off the cylinder block (part 25) from the shaft, with two screwdrivers.

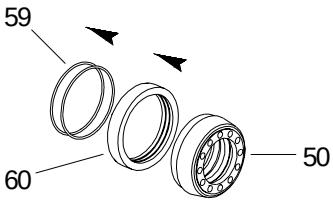


NOTE! If the distribution valve (part 50) is detached with the cylinder block take care not to drop the distribution valve during removal.

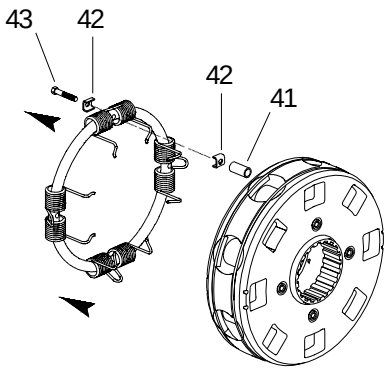
3. Detach the distribution valve (part 50). The distribution valve will lift off its seals. If necessary, lift the rear cover (part 65) upwards with a strong jerk or lift the cover and tap the shaft end with a rubber mallet.

4. Do not remove the distribution valve caps (part 57) unless they are damaged.

5. Dismantle the distribution valve only if excessive wear is observed. Remove the support ring (part 60) from the distribution valve. Remove the sealing ring (part 59) from the support ring.

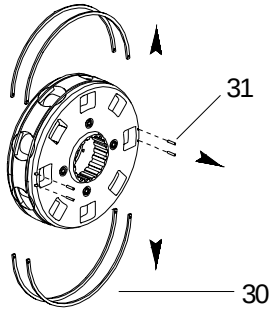


6. Removing freewheeling mechanism (optional)



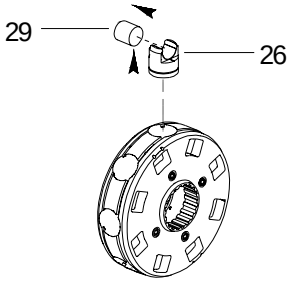
- Unscrew the freewheeling mechanism fastening screws (part 43). **Watch out for releasing springs!** Loosen the spacer sleeves (part 41), U-plates (part 42) and the freewheeling mechanism from the cylinder block.

- Do not dismantle the freewheeling mechanism unless damage or excessive wear is observed.



7. Tap loose the piston guide expander pins (part 31). Remove the piston guide rings (part 30) from the grooves on the cylinder block.

8. Pull out the pistons (part 26) from the cylinder block and remove the cam rollers (part 29) from the pistons.



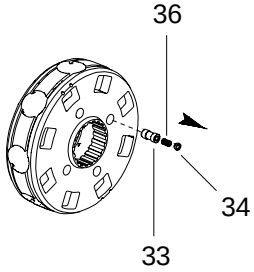
9. Check the condition of the pistons, piston inserts, cam rollers, cam ring and the cylinder block. Replace, if any damage is observed.

10. Dismantling poppet spool (optional), only in 2-speed motors

- Open plugs (part 34) in cylinder block using an allen key.

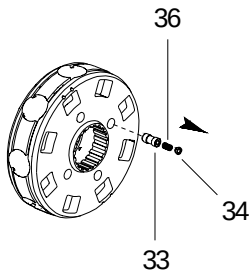
(Table 4) Allen key sizes:

BBC01	BBC02	BBC03	BBC04	BBC05
1/4"	1/4"	8 mm	8 mm	8 mm



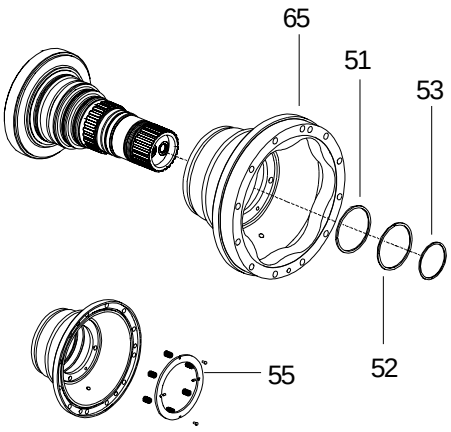
- Remove springs (part 33) from the poppet spool holes.

- Remove poppet spools (part 36) from the cylinder assembly. Check the sealing surface condition of poppet spools. Replace the poppet spools if any damage is observed. Do not mix up the order of the spools.



5. Dismantling rear cover

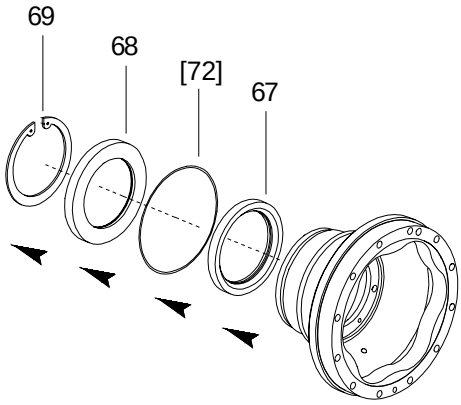
1. Remove the sealing rings (parts 51, 52 and 53) from the shaft grooves. Lift the rear cover (part 65) completely off the shaft.



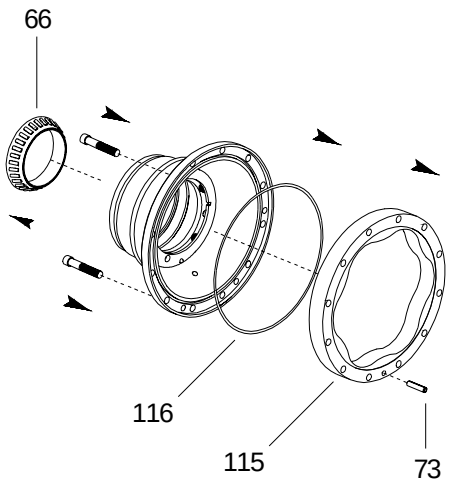
NOTE! Do not dismantle the rotation unit for distribution valve (part 55) unless it shows signs of damage or the deflection is uneven.

2. Remove the retainer ring (part 69), support ring (part 68), o-ring (part 72) [not in all models] and shaft seal (part 67) from the rear cover.

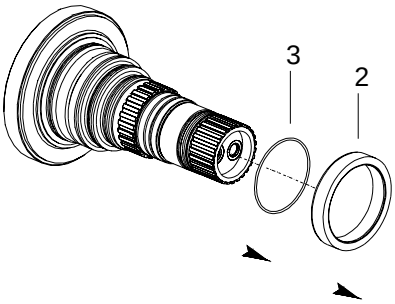
3. Lift the inner bearing race (part 66) from the rear cover. Only detach the outer bearing race from the rear cover if the bearing is being replaced.



4. By hand, screw three cover bolts into the threaded extraction holes on the rear cover. Detach the cam ring (part 115) by evenly tightening the bolts. Tap the expander pin (part 73) loose from the cam ring. Remove the o-ring (part 116) from the rear cover groove.



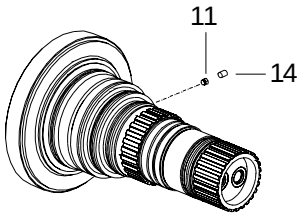
6. Dismantling the shaft



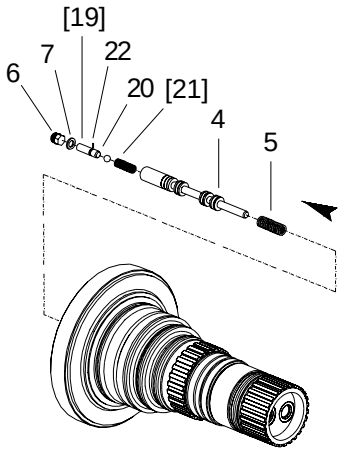
1. If needed heat up the shaft seal collar (part 2) to a temperarure of about +80°C [176°F]. Pry the collar (part 2) from the shaft. Remove the o-ring (part 3) from the shaft groove.

2. Dismantling 2-speed parts (optional)

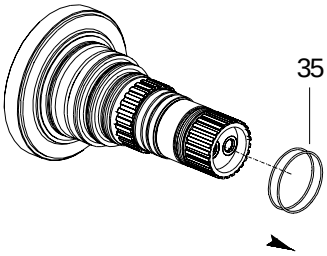
Only if check valve malfunction is observed.



- Remove the plugs (part 14) with 8 mm allen key and check valves (part 11) with 7 mm allen key. Inspect the functionality and cleanliness of the check valve.

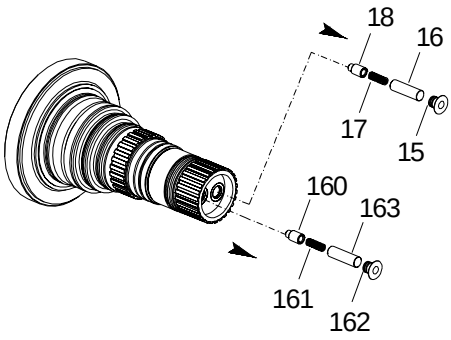


- Unscrew the plug (part 6) with 8 mm allen key from the shaft with an allen key. It may be necessary to heat the plug to ease unscrewing. Remove the orifice (part 7), damper piston (part 19) and spring (part 21). Dismantle the damper piston if damage or dirt is observed (parts 19, 20 and 22). Remove spool (part 4) and spring (part 5) from shaft hole. [Parts 19 and 21 are not in all models].



- Remove the seal rings (part 35) from the shaft only if damage is observed.

- Remove the plugs (parts 15 and 162) using an allen key as well as caps (parts 16 and 163), springs (parts 17 and 161) and valves (parts 18 and 160). Check the sealing surface of the case pressure valve and the filling valve.



CLEANING AND INSPECTION OF THE PARTS

NOTE! Clean all parts thoroughly. Inspect the following points very carefully:

- The oil distribution surfaces of the distribution valve and the cylinder block must be unmarked and smooth.

- The rolling surface of the cam ring and cam rollers must be unmarked and smooth.

- Piston insert surface must be unmarked and smooth.

- Cylinder surfaces and pistons must be faultless.

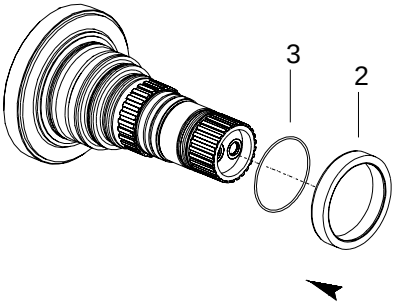
- The 2-speed spool surface must be unmarked.

- The cylinder block poppet spool must be undamaged and smooth.

NOTE! Use new seals for reassembling.

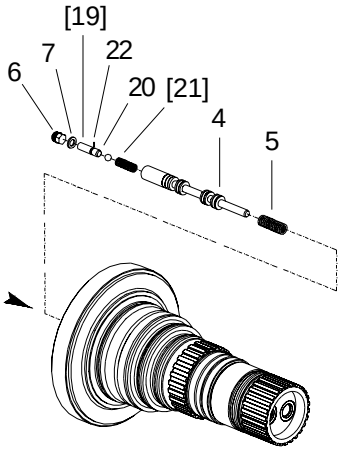
MOTOR ASSEMBLING

7. Shaft



1. Place the oiled o-ring (part 3) onto the shaft groove. If needed heat the shaft seal collar (part 2) to a temperature of about +80°C [176°F]. Tap the collar (part 2) onto the shaft.

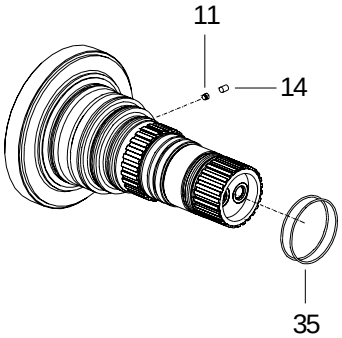
2. Installation of the 2-speed parts (optional)



- Insert the spring (part 5) onto the 2-speed spool. Insert another spring (part 21) into the hole at the end of the 2-speed spool and place the oiled 2-speed spool into the shaft hole. Place the assembled damper piston (part 19) and orifice (part 7) into the 2-speed spool hole. Screw tightly the 2-speed spool plug (part 6) with 8 mm allen key. Use Loctite 243-sealant to sealing.

- Place the sealing rings (part 35) onto the shaft.

NOTE! Clean the check valves (part 11) and threads in the shaft very carefully. Apply the Loctite 275 on the thread.

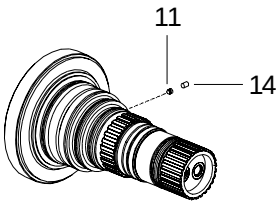


- Screw the check valves (part 11) into the shaft using 7 mm allen key. The tightening torque of the check valve is 15 Nm [11,1 lbf.ft].

- Ensure the mechanical lock of the check valve using the special tool (CN9246) and a hammer.

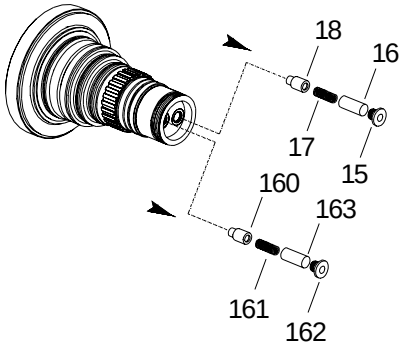
- Screw the plug (part 14) with 8 mm allen key into the shaft and seal the threads with Loctite 275.

- Place the case pressure valve (part 18), spring (part 17) and plug (part 16) into the hole at end of the shaft. Screw the plug (part 15) onto the shaft using an allen key.



NOTE! The case pressure valve is marked #1.

- Place the filling valve (part 160), spring (part 161) and plug (part 163) into the hole at the end of the shaft. Screw the plug (part 162) into the shaft.



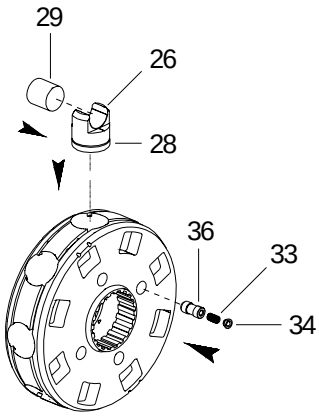
NOTE! The filling valve is marked #2.

NOTE! If the shaft is new, tap the valves carefully in place and ensure the tightness of the sealing surface. The sealing surface should display an intact grey circle following the tap.

8. Cylinder block

1. Poppet valve installation (optional), 2-speed motor

- Insert the valves (part 36) to same cylinder block holes as they were. Insert springs (part 33) and screw the cylinder block plugs (part 34) using an allen key. The tightening torque is 50 ± 2 Nm.

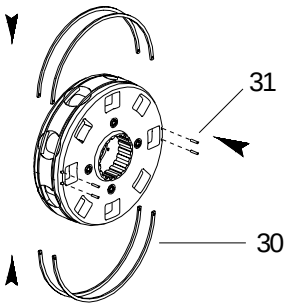


(Table 5) Cylinder block plug allen key sizes:

BBC01	BBC02	BBC03	BBC04	BBC05
1/4"	1/4"	1/4"	8 mm	8 mm

2. Insert the piston rings (part 28), if they have been removed. Insert the oiled cam rollers (part 29) into pistons. Place the oiled pistons (part 26) into cylinder block.

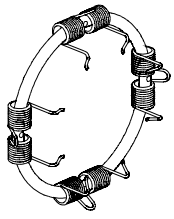
3. Place the guide rings (part 30) into cylinder block grooves. Tap the expander pins (part 31) into their holes.



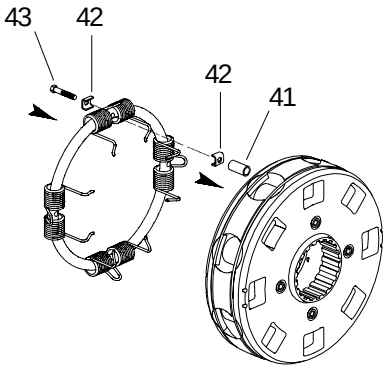
NOTE! The shamfered sides of the guide rings should face away from the pistons, with the flat side facing the piston rollers.

4. Freewheeling mechanism installation (optional)

- Assemble the freewheeling mechanism, only if it has been dismantled.

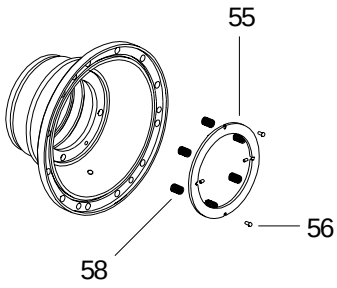


- Insert the spring heads of the assembled freewheeling mechanism into the cylinder assembly grooves. Place the U-plates (part 42) and spacer sleeves (part 41) in place against the spring. Insert screws (part 43) through the U-plates and spacer sleeves and turn into place. Tighten the screws.



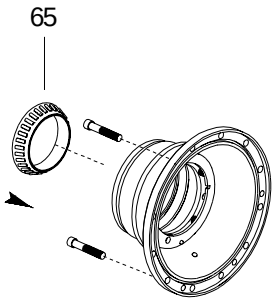
9. Rear cover

1. If the old rotating unit for the distribution valve has been removed; insert the springs (part 58) into the holes found in the rear cover, place the connecting ring (part 55) on top of the springs and tap the drive pins (part 56) into the rear cover holes.

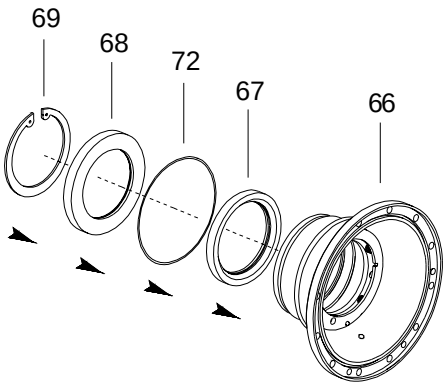


NOTE! Use new drive pins.

2. If the old outer bearing race has been removed, press the new outer bearing race into the rear cover. Install inner bearing race (part 65) into the rear cover

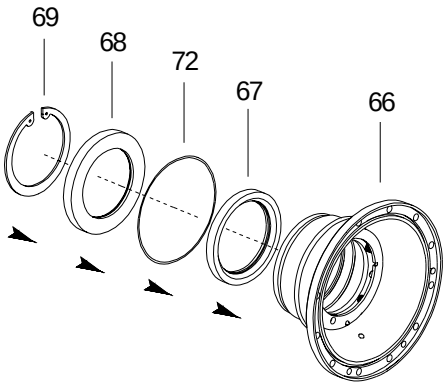


3. Install the shaft seal (part 67) into the rear cover with the open side of the seal facing the inside of the motor. Press until the shaft seal lines up with the shoulder inside the rear cover.



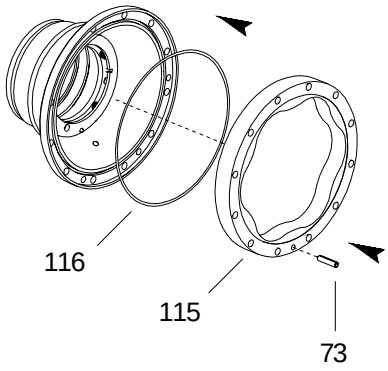
3.1 Models, where the shaft seal is installed into support ring:

Push the shaft seal (part 67) against the support ring (part 68); with open side of the seal facing the inside of the motor. Use Loctite 542 sealant on the outside of the seal. Place a lubricated o-ring (part 72) onto the support ring groove. Place the assembled support ring (part 68) into the rear cover; press until the shaft seal lines up with the shoulder inside the rear cover (part 70). Ensure that the locking pin is in line with support ring hole.

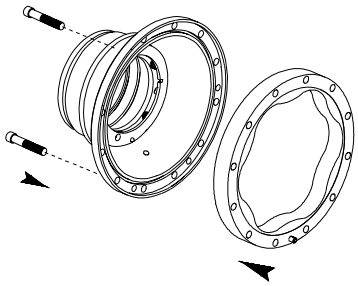


4. Insert the retainer ring (part 69) into its groove. Apply waterproof lubricant to the shaft seal lip.

5. Tap the expander pin (part 73) into cam ring hole. Insert the lubricated o-ring (part 116) into the cylinder housing groove.



6. Mount the cam ring into the rear cover, align the pin into its hole, tighten evenly either with a press or with four casing bolts. Make sure that the expander pin doesn't protrude through the cam ring.

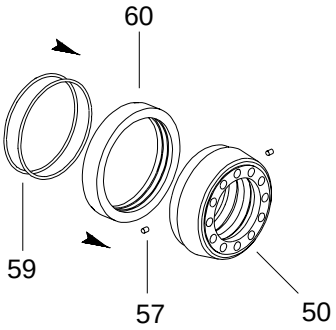


10. Distribution valve

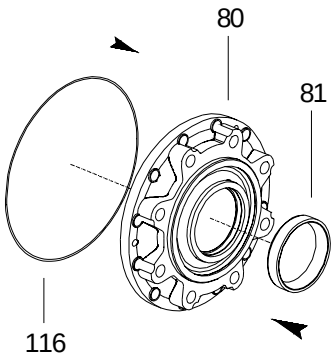
1. Place the lubricated sealing rings (part 59) into their grooves on the support ring (part 60).

2. Lubricate the seal surface of the distribution valve and place the support ring onto the distribution valve (osa 50).

3. Insert two pins (part 57) into the holes on the distribution valve.



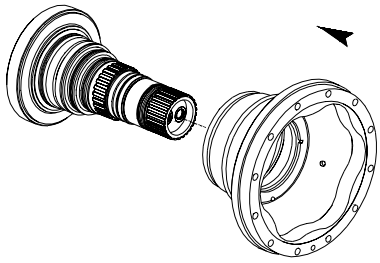
11. Hub cover



1. If the old outer bearing race has been removed press a new one (part 81) into the hub cover (part 80). Instal inner bearing race.

2. Insert a lubricated o-ring (part 116) into the hub cover groove.

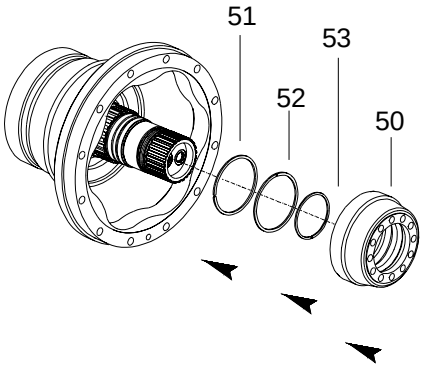
12. Re-assembly



1. Place the assembled rear cover onto the shaft. Carefully tap the inner bearing race tightly against the wear ring of the shaft seal.

NOTE! Beware of the sealing ring grooves on the shaft.

2. Place three sealing rings (parts 51,52 and 53) onto the grooves on the shaft.

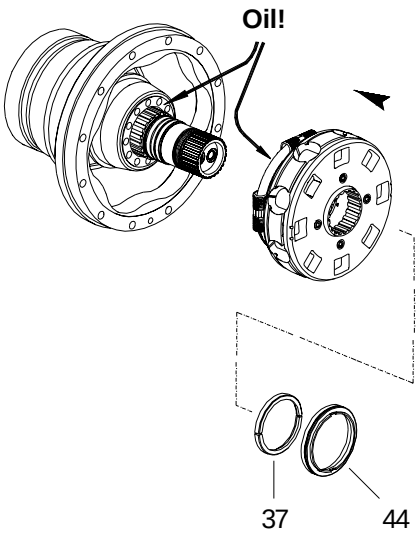


4. Lubricate the sealing rings (parts 51, 52 and 53) as well as the seal surface inside the distribution valve. Position the sealing rings carefully in the center of the shaft.

5. Carefully lift the distribution valve (part 50) into place.

6. Rotate the distribution valve at the same time as pressing it lightly and evenly by hand. When the distribution valve pins line up with the connecting ring grooves, apply a little more force to the distribution valve. Where necessary, tap the distribution valve lightly with a soft device. **Do not tap the distribution surface.**

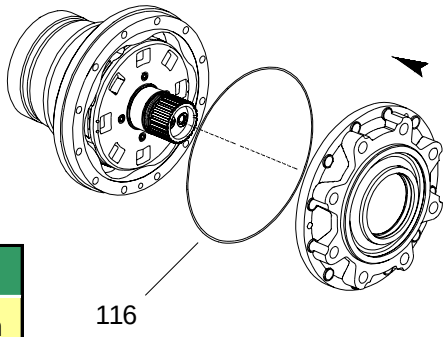
7. Clean the distribution surface in the distribution valve and in the cylinder block, and oil them. Fit the assembled cylinder block onto the shaft splines.



8. Press the cylinder block and place the retainer ring halves (part 37) onto the shaft groove. Position the locking ring (part 44) over the retainer ring halves.

9. Place the hub cover into place, ensure that none of the hub housing threaded extraction holes line up with the expander pin, and that the o-ring (part 116) is in its groove.

10. Tighten the hub cover into place evenly using cover bolts. Tighten all cover bolts around the circumference of the hub cover.



(Table 6) Tightening torque of the cover bolts and allen key sizes:

BBC01	BBC02	BBC03	BBC04	BBC05
77 Nm	135 Nm	135 Nm	135 Nm	135 Nm
8 mm	10 mm	10 mm	10 mm	10 mm

Bearing installation using hydraulic compression

11. Place both retainer ring halves onto the shaft groove [only in models with shims]. Position the bearing press tool over the hub bearing. Remove all gaps between the hub cover and the bearing by applying a force [See table 7, pretightening] to the bearing and rotate the cover a few turns by hand. Release the pressure and retighten applying the force [See table 7, measuring].

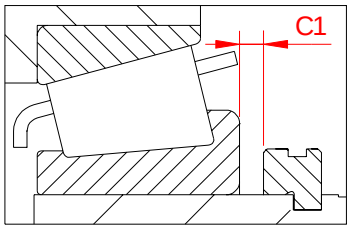
(Table 7) Bearing pressure force [kN]:

	BBC01	BBC02	BBC03	BBC04	BBC05
Pretightening	29,4	34,3	39,2	44,2	49,1
Measuring	19,6	24,5	24,5	29,4	29,4

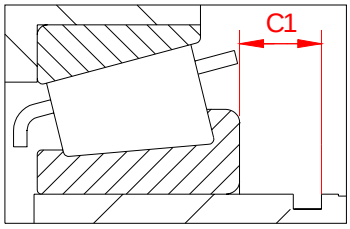
11a) [Models with shims] Measure and record the gap (C1) between the bearing and the retainer ring halves.

11b) [Models without shims] Measure and record the gap (C1) between the bearing and the upper edge of the retainer ring groove.

Models with shims



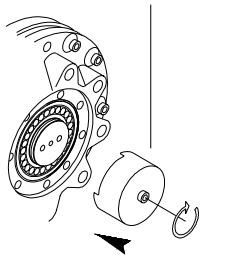
Models without shims



Bearing installation without hydraulic compression

12. Place the press tool, with a bolt (M10, 12,9) in the centre, onto the hub bearing. Remove the gap between the hub cover and the bearing by tightening the press tool tension screw [See table 9, pretightening] and rotate the cover a few turns by hand. Loosen the tension screw and retighten [See table 9, measuring].

Press tool



12a) [Models with shims] Measure and record the gap (C1) between the bearing and the retainer ring halves.

12b) [Models without shims] Measure and record the gap (C1) between the bearing and the upper edge of the retainer ring groove. You can use thin retaining ring halves to ease measuring.

(Table 8) Hub cover bearing tool numbers:

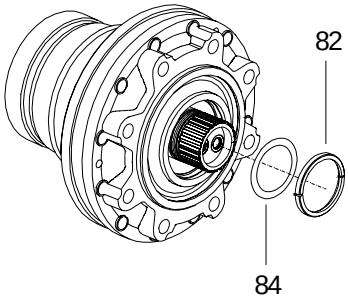
BBC01	BBC02	BBC03	BBC04	BBC05
CN8704	CN8726	CN8692	CN8919	CN8718

(Table 9) Bearing tightening values [Nm]:

	BBC01	BBC02	BBC03	BBC04	BBC05
Pretightening	50	55	65	70	75
Measuring	33	41	41	50	50

13. Remove the retainer ring halves from the shaft groove and loosen the press tool.

13a) [Models with shims] Position the required quantity of the shims (part 84) between the bearing and the retainer ring halves: recorded gap (C1) +0,1...0,2 mm [0,004”...0,008”]. Place the thickest shims against the retainer ring halves and the bearing. Pre-tighten the bearing applying force by tightening the tension screw [See table 9, pretightening].



13b) [Models without shims] Select retainer ring halves with thicknes of recorded gap (C1) +0,1...0,2 mm [0,004”...0,008”]. Pre-tighten the bearing applying force by tightening the tension screw [See table 9, pretightening].

14. Lubricate the shims and retainer rings thoroughly prior to installation. Ensure that the retainer ring halves do not contain sharp edges. Position one half of the retainer ring (part 82) onto the shaft groove. Strike the center of the retainer ring halve with a special tool until it begins to expand at the sides. Following this, tap the other half of the retainer ring halve onto the groove. Tap, moving from one end of the ring to the other, until the retainer ring half reaches the bottom of the groove.

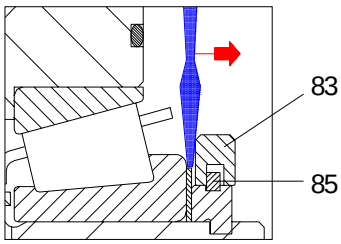
15. With the first half of the retainer ring in place, loosen and remove the hub bearing press tool. Position the other half of the retainer ring into its groove and tap into place.

16. Using the tool (table 10), place the retainer ring (part 85) and the locking ring (part 83) on top of the retainer ring halves.

(Table 10) Retainer ring installation tool number:

BBC01	BBC02	BBC03	BBC04	BBC05
N8703	N8705			N9213

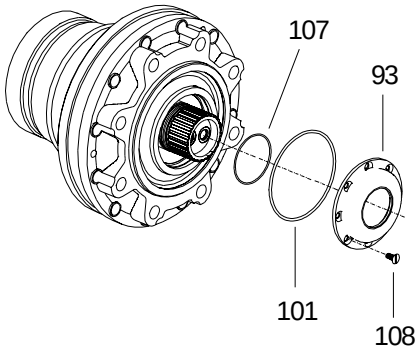
NOTE! Ensure that retainer ring is locked into its groove.



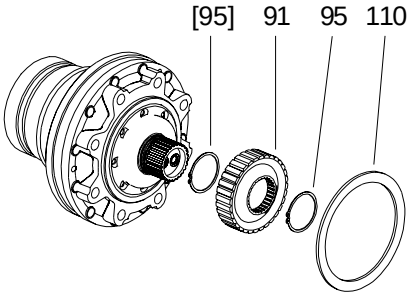
17. Position the sealing ring (part 107) onto the shaft groove.

18. Position the o-ring (part 101) onto hub cover groove.

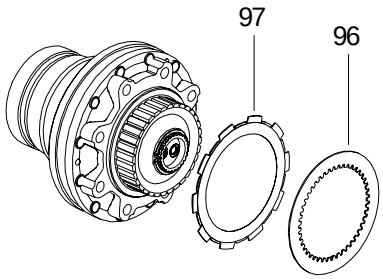
19. Lubricate the spacer plate sealing surface. Place the spacer plate (part 93) onto the hub housing. Be careful not to snap the sealing ring. Fasten the spacer plate using screws (part 108) or retainer ring. Apply Loctite 222 to secure the screws.



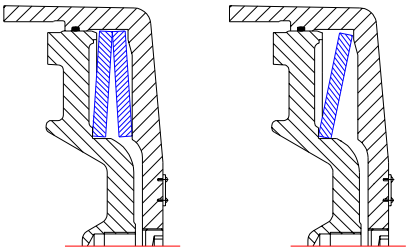
13. Brake reassembly



1. Position the inner retainer ring (part 95) onto the shaft [part 95 is not in all models]. Position the brake spline (part 91) onto the shaft spline and lock by placing the outer retainer ring (part 95) into the shaft groove.

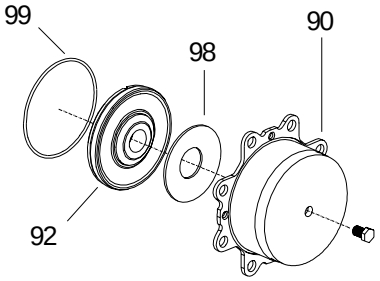


2. Place the brake discs (parts 97 and 96) onto the brake spline. First install the brake disc with friction surface (usually, friction surfaced brake discs, gear teeth appear on the outside). Position the discs in such a way that the discs have gear teeth alternately on the outerside and inside respectively. Line up the discs.

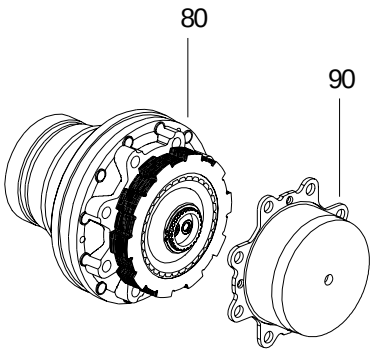


3. Position the disc spring or springs (part 98), lubricated o-ring (part 99) and brake piston (part 92) into the brake cover (part 90)

WARNING! Secure disc springs, o-ring and brake piston with brake release bolt. (See page 2; Dismantling the brake)



4. Position the assembled brake cover (part 90) - line up the brake cover fastening bolt holes with the tapped holes in the hub cover (part 80). Ensure that all gaps have been eliminated. Remove the brake release bolt. Measure the pre-tightening value of the brake disc spring. The clearance between the hub cover and brake cover is contained in the table.

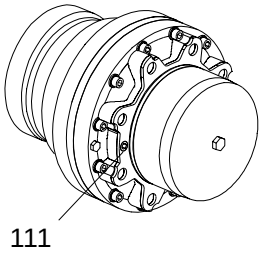


(Table 11) Brake housing pre-tightening values [mm]:

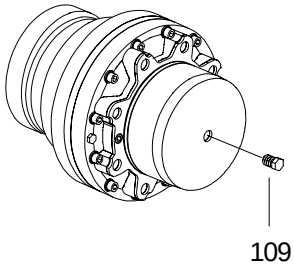
BBC01	BBC02	BBC03	BBC04	BBC05
$5,4 \pm 0,2$	$5,6 \pm 0,2$	$4,8 \pm 0,2$	$4,2 \pm 0,2$	$9,0\ ^{+0,3}_{0}$

Where the pre-tightening value is lower than the value shown in the table, place the required number of adjusting shims (part 110) between the hub cover and the first brake disc in order to achieve the appropriate pretightening.

5. Release the brake: Insert the brake release bolt with nut into the hole in the center of the brake housing. Screw the bolt with nut into the bottom of tapped hole located on the brake piston. Tighten the release **nut** one full turn in order to release the brake.



6. Insert and tighten brake housing fastening bolts (part 111). Remove the brake release bolt and instal the tapered plug (part 109) in the centre of the brake cover.



14. After assembly

Before using the motor: Turn the motor to such a position that one of the bleed screws is in the topmost position. Unfasten the bleed screw half a turn. Fill the motor housing with oil. Retighten the bleed screw when oil is pouring out from the outer end of the screw. **NOTE! Unfilled motor casing will cause major motor damage!**

Test run the motor, where possible.

NOTE! When test running a multiple disc brake motor, wheel fastening screws must be in place and tightly secured.

MAINTENANCE

15. Recommended oil

Any mineral oil to be used should meet the following requirements:

- The viscosity-index must be no less than 100. If the oil contains additives to improve viscosity-index, their effect must be as long-lasting as possible. Oil should retain its required viscosity throughout its life.

- The lowest accetable viscosity is 15 cSt.

- Recommended viscosity area at operating temperature is 25-40 cSt. At reduced speed, to achieve smoother running, a more viscous oil can be employed.

- Oil temperatures of over 70°C (160°F) should be avoided as the useful life of the oil and of the entire system is drastically reduced from the effects of temperatures above this.

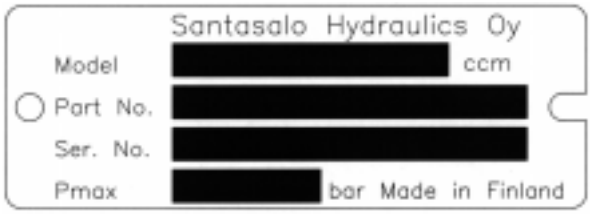
- Oil additives must comply with the API classification of SC motor oils.

We recommend hydraulic oils and SC, SD, SE and SF motor oils. In certain circumstances, the use of non-flammable fluids, such as HFB and HFC, may be permitted. If using other fluids, please contact Santasalo Hydraulics or our represantative.

16. Spare parts

When ordering spare parts, please provide the following information:

- part name
- part number
- quantity
- motor serial number (Serial No.)
- motor part number (Part No.)



Santasalo Hydraulics Oy
PO Box 633, Fin-40101, Jyväskylä, Finland
Tel. +358 2048 4130, fax. +358 2048 4131
email: info.hydraulics@santasalo.com
http://www.santasalohydraulics.com